

Appln. No.: 09/601,234 MAT-7999US
Response Dated: April 5, 2004
Reply to Notice of: March 23, 2004

Amendment to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A non-aqueous electrolyte secondary battery comprising:

a positive electrode,

a negative electrode capable of intercalating and de-intercalating lithium,

a non-aqueous electrolyte solution, and

a polymer gel electrolyte, said polymer gel electrolyte comprising a polymer,

wherein:

said negative electrode comprises a plurality of composite particles,

each of said composite particles comprises: a central portion consisting essentially of at least one element selected from the group consisting of tin, silicon, and zinc; and a coating at least partially around said central portion,

said coating comprises a solid solution or an inter-metallic compound, and

said solid solution or inter-metallic compound comprises: a) at least one element selected from the group consisting of tin, silicon, and zinc, and b) at least one additional element, said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements and group 14 elements exclusive of carbon, and exclusive of said element selected from the group consisting of tin, silicon, and zinc, in said solid solution or inter-metallic compound.

2. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1, wherein said positive electrode comprises a lithium-containing composite

Appln. No.: 09/601,234 MAT-7999US
Response Dated: April 5, 2004
Reply to Notice of: March 23, 2004

oxide and said polymer, and said negative electrode comprises said composite particles and said polymer.

3. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said polymer is a polyalkylene oxide.

4. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said polymer is a polymer or a copolymer comprising at least one monomer selected from the group consisting of acrylonitrile, vinylidene fluoride, hexafluoro-propylene, tetrafluoro-ethylene, and perfluoro-alkyl vinyl ether.

5. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said polymer is a polyester.

6. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said polymer is a copolymer of a methacrylate and an ethylene oxide.

7. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said polymer gel electrolyte comprises at least one structural reinforcement selected from the group consisting of hydrophobic treated particulates, fiber fabrics of polyolefin polymers, and non-woven fabrics of polyolefin polymers.

8. (Currently Amended) A non-aqueous electrolyte secondary battery comprising:

a positive electrode,

a negative electrode capable of intercalating and de-intercalating lithium,

a non-aqueous electrolyte solution, and

a lithium ion conductive glass solid electrolyte,

wherein:

Appln. No.:
Response Dated:
Reply to Notice of:

09/601,234
April 5, 2004
March 23, 2004

MAT-7999US

said negative electrode comprises a plurality of composite particles, each of said composite particles comprises: a central portion consisting essentially of at least one element selected from the group consisting of tin, silicon, and zinc; and a coating at least partially around said central portion,

said coating comprises at least one of a solid solution and an inter-metallic compound, and

said solid solution or inter-metallic compound comprises: a) at least one element selected from the group consisting of tin, silicon, and zinc, and b) at least one additional element, said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements and group 14 elements exclusive of carbon, and exclusive of said element selected from the group consisting of tin, silicon, and zinc in said solid solution or inter-metallic compound.

9. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 8, wherein said lithium ion conductive glass solid electrolyte is synthesized from:

a first component comprising a lithium sulfide;

a second component comprising a silicon sulfide, a phosphor sulfide or a boron sulfide; and

a third component comprising lithium phosphate, lithium sulfate, lithium borate, or lithium silicate.

10. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said at least one element selected from the group consisting of tin, silicon, and zinc in said central portion is tin, and said at least one element selected from the group consisting of tin, silicon, and zinc in said solid solution or inter-metallic compound is tin.

11. (Previously Presented) The non-aqueous electrolyte secondary battery

Appln. No.:
Response Dated:
Reply to Notice of:

09/601,234
April 5, 2004
March 23, 2004

MAT-7999US

of claim 1 or claim 2, wherein said at least one element selected from the group consisting of tin, silicon, and zinc in said central portion is silicon, and said at least one element selected from the group consisting of tin, silicon, and zinc in said solid solution or inter-metallic compound is silicon.

12. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said at least one element selected from the group consisting of tin, silicon, and zinc in said central portion is zinc, and said at least one element selected from the group consisting of tin, silicon, and zinc in said solid solution or inter-metallic compound is zinc.

13. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 1 or claim 2, wherein said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements and group 14 elements exclusive of carbon, and exclusive of said element selected from the group consisting of tin, silicon, and zinc, is selected from the group consisting of Mg, Fe, Mo, Cd, In, Pb, Co, Ni, Al, Cu, V, and Ge.

14. (Currently Amended) A non-aqueous electrolyte secondary battery comprising:

a positive electrode,

a negative electrode capable of intercalating and de-intercalating lithium,

a non-aqueous electrolyte solution; and

a solid an electrolyte,

wherein:

said negative electrode comprises a plurality of composite particles,

each of said composite particles comprises a central portion comprising silicon, and a coating at least partially around said central portion,

said coating comprises a solid solution or an inter-metallic compound, and

said solid solution or inter-metallic compound comprises: a) silicon, and b) at least one additional element, said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements, and group 14 elements exclusive of carbon and silicon; and

said ~~solid~~ electrolyte is a polymer gel electrolyte comprising a polymer, or a lithium ion conductive glass solid electrolyte.

15. (Currently Amended) The non-aqueous electrolyte secondary battery of claim 14, wherein said electrolyte is said polymer gel electrolyte, said positive electrode comprises a lithium-containing composite oxide and said polymer in said polymer gel electrolyte, and said negative electrode comprises said composite particles and said polymer.

16. (Withdrawn) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements, and group 14 elements exclusive of carbon and silicon is selected from the group consisting of Mg, Co, Ni, Zn, Al, and Sn.

17. (Currently Amended) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a polymer or a copolymer comprising at least one monomer selected from the group consisting of acrylonitrile, vinylidene fluoride, hexafluoro-propylene, tetrafluoro-ethylene, and perfluoro-alkyl vinyl ether.

18. (Currently Amended) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a polyester.

19. (Currently Amended) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a copolymer of a methacrylate and an ethylene oxide.

20. (Currently Amended) The non-aqueous electrolyte secondary battery

of claim 14 or claim 15, wherein said electrolyte is said polymer gel electrolyte and said polymer gel electrolyte comprises at least one structural reinforcement selected from the group consisting of hydrophobic treated particulates, fiber fabrics of polyolefin polymers, and non-woven fabrics of polyolefin polymers.

21. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 8, wherein said at least one element selected from the group consisting of tin, silicon, and zinc in said central portion is silicon, and said at least one element selected from the group consisting of tin, silicon, and zinc in said solid solution or inter-metallic compound is silicon.

22. (Previously Presented) The non-aqueous electrolyte secondary battery of claim 8, wherein said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements and group 14 elements exclusive of carbon, and exclusive of said element selected from the group consisting of tin, silicon, and zinc, is selected from the group consisting of Mg, Fe, Mo, Cd, In, Pb, Co, Ni, Al, Cu, V, and Ge.

23. (New) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said central portion consists essentially of silicon.

24. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said additional element selected from the group consisting of group 2 elements, transition elements, group 12 elements, group 13 elements, and group 14 elements exclusive of carbon and silicon is selected from the group consisting of Mg, Co, Ni, Zn, Al, and Sn.

25. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said polymer is a polyalkylene oxide.

26. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a polymer or a copolymer comprising at least one monomer selected from the group consisting of acrylonitrile, vinylidene fluoride, hexafluoropropylene, tetrafluoro-ethylene, and perfluoro-alkyl vinyl ether.

Appln. No.:
Response Dated:
Reply to Notice of:

09/601,234
April 5, 2004
March 23, 2004

MAT-7999US

27. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a polyester.

28. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a copolymer of a methacrylate and an ethylene oxide.

29. (New) The non-aqueous electrolyte secondary battery of claim 23, wherein said electrolyte is said polymer gel electrolyte and said polymer gel electrolyte comprises at least one structural reinforcement selected from the group consisting of hydrophobic treated particulates, fiber fabrics of polyolefin polymers, and non-woven fabrics of polyolefin polymers.

30. (New) The non-aqueous electrolyte secondary battery of claim 14 or claim 15, wherein said electrolyte is said polymer gel electrolyte and said polymer in said polymer gel electrolyte is a polyalkylene oxide.